INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

30 April 2015 (pm)

Subject ST9 – Enterprise Risk Management

Time allowed: Three hours

INSTRUCTIONS TO THE CANDIDATE

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*

2. *You have 15 minutes before the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*

3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*

4. *Mark allocations are shown in brackets.*

5. *Attempt all three questions, beginning your answer to each question on a new page.*

6. *Candidates should show calculations where this is appropriate.*

AT THE END OF THE EXAMINATION

Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.

In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.

1 The Solvanian Affluent Retirement Society ("SARS") is a life insurance company based in the country of Solvania. It writes both unit-linked savings and conventional immediate annuity business.

The team reporting to the Chief Financial Officer (CFO) has been working on the economic capital assessment for the most recent year end. The economic capital is a Value at Risk (VaR) based measure set at the 99.5th percentile over a one year time horizon. The base balance sheet that is to be stressed has already been audited and signed off.

The unit-linked savings business exposes SARS to both equity return and lapse risk, amongst other risks. The Chief Risk Officer (CRO) has been asked for his view on the equity return and lapse stresses that have been proposed for the economic capital assessment. He has been provided with the following analysis supporting the proposed equity return stress:

Graph showing the movement in the Solvanian stock market price index

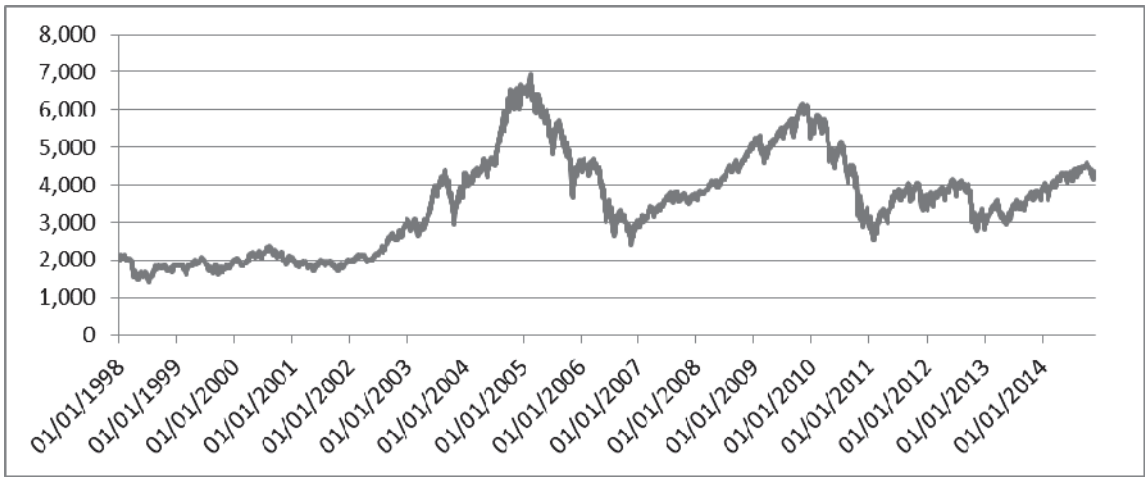


Table showing the main economic crises and their impact on the Solvanian stock market

Period	*Equity price index return*	*Description*
27/08/03–20/10/03	–31%	Bowser crisis: A short-lived crisis during which Solvania's aluminium industry faced a severe water shortage which resulted in a reduction in the production of aluminium. Once replacement water transportation was established, production returned to prior levels within a few months. The stock market went on to recover the losses.
18/02/05–20/11/06	–65%	Global crisis: Solvania's boom continued after the Bowser crisis, along with strong economic growth in the rest of the world. However, over-leverage resulted in a global crisis with reduced demand for aluminium, Solvania's primary export. Demand did not pick up until late into 2006 following coordinated reductions in interest rates by central banks, with interest rates remaining at these historic lows.
06/11/09–31/01/11	–59%	Aluminium crisis: Whilst demand increased slowly to pre-Global crisis levels, supply increased from lower cost countries resulting in significant price falls for aluminium. Consequently, the stock market, which is highly focused on the aluminium industry, failed to reach its previous highs. As supply continued to flood the market, Solvania's stock market crashed by almost 60%.

Graph showing the empirical distribution of equity price index movements (i.e. frequency of actual observations)

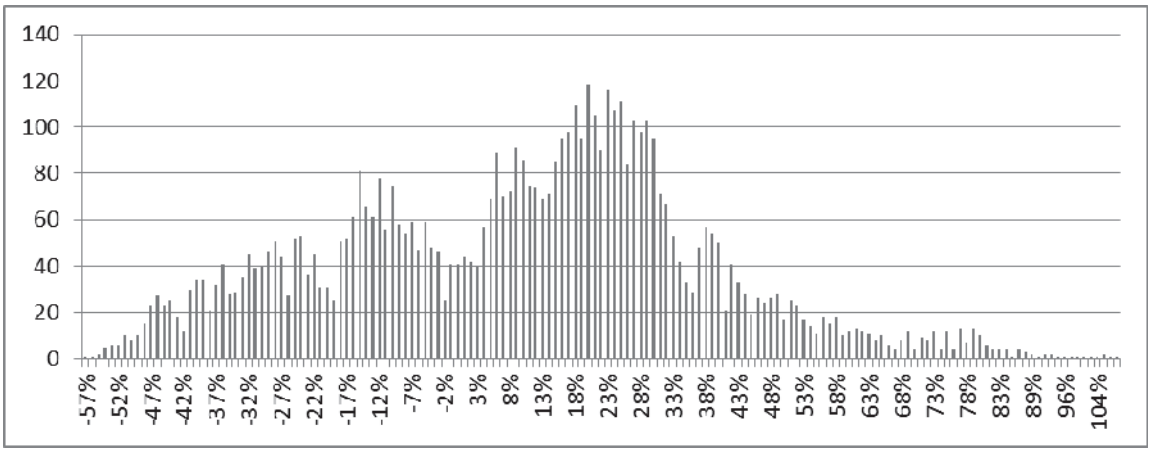


Table showing selected percentiles for the equity price index movement empirical distribution and fitted t-distribution

Percentile	*Empirical distribution*	*Fitted t-distribution*
0.5th	83%	93%
5th	55%	59%
20th	29%	34%
50th	11%	9%
80th	–17%	–15%
95th	–39%	–40%
99.5th	–52%	–74%

The CFO has therefore proposed a 99.5th percentile stress for equity returns of –74%.

(i) Assess the suitability of the fitted *t*-distribution and the overall approach taken to determine this proposed equity stress. [8]

(ii) Propose further analysis or adjustments that the CRO should suggest in his response. [3]

The CRO has also been provided with the following analysis supporting the proposed lapse stress:

Year	*Equity price index change*	*Expected lapses*	*Actual lapses*	*Difference*
1998	–5%	4.0%	4.1%	0.1%
1999	7%	4.0%	2.0%	–2.0%
2000	1%	4.0%	4.3%	0.3%
2001	5%	4.0%	2.8%	–1.2%
2002	56%	4.0%	3.0%	–1.0%
2003	35%	4.0%	8.1%	4.1%
2004	59%	5.0%	3.4%	–1.6%
2005	–32%	5.0%	4.3%	–0.7%
2006	–34%	5.0%	5.4%	0.4%
2007	25%	5.0%	5.1%	0.1%
2008	37%	5.0%	3.9%	–1.1%
2009	5%	5.0%	6.4%	1.4%
2010	–47%	5.0%	6.7%	1.7%
2011	26%	6.0%	5.7%	–0.3%
2012	–18%	6.0%	5.2%	–0.8%
2013	35%	6.0%	6.5%	0.5%
2014	11%	6.0%	6.3%	0.3%

Due to the limited number of data points available, the CFO proposes the use of a lapse stress involving an increase in lapse rates of 4.1%, which is the highest difference between actual and expected lapses as observed over the period from 1998 to 2014.

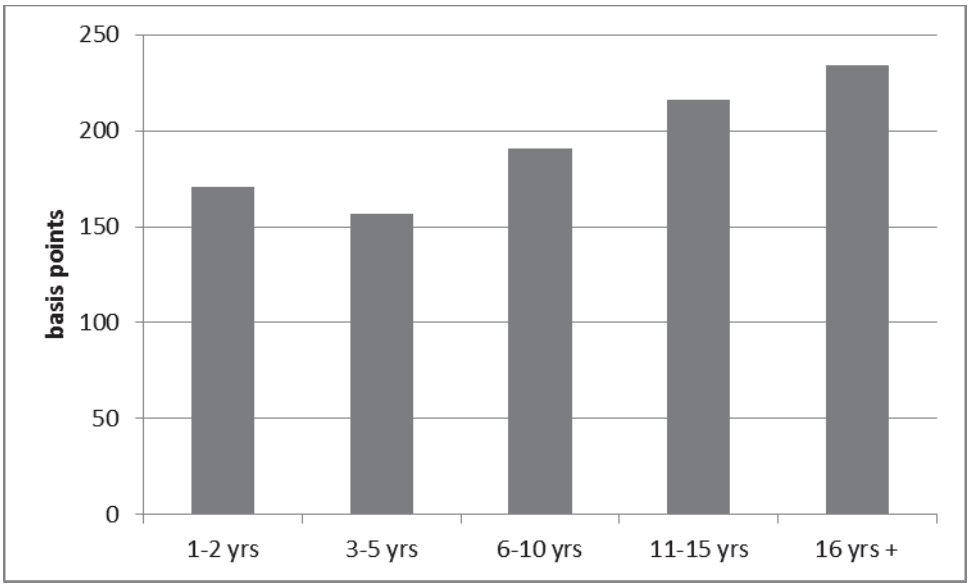
(iii) Assess the suitability of the proposed lapse stress, taking into consideration the features of the data provided above. [7]

The immediate annuity business exposes SARS to credit and interest rate risk, amongst other risks.

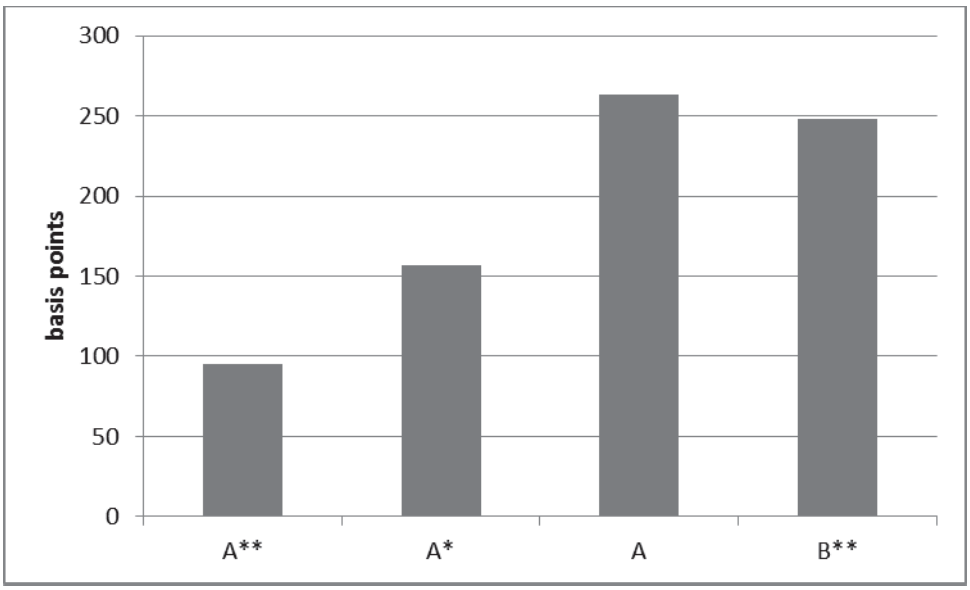
The CFO's team has analysed actual credit spread movement data for each of the investment grade rating categories A**, A*, A and B**. The rating category A** is the rating category reserved for counterparties with the smallest chance of default, followed by A* and so on. The data used is for corporate bonds issued within Solvania and is from 1998 to 2014.

The team has identified a set of proposed 99.5th percentile credit spread movements for each rating category and by term to maturity. A subset of these proposed 99.5th percentiles is illustrated in the graphs below:

A rated corporate bonds only, by term to maturity*



Outstanding duration 3–5 years bonds only, by credit rating



The CFO's team is unsure as to how to interpret these figures and has asked for the CRO's views.

(iv) Explain whether the graphs demonstrate the features that would be expected in practice. [3]

(v) Suggest possible extensions that could be made to the analysis. [4]

The CFO's team is now quantifying the economic capital for its interest rate risk, which relates to bond yields. It has decided that it wishes to model future risk-free bond yields using principal component analysis (PCA).

(vi) Describe the approach that would be taken. [You are not required to describe a method for determining the principal components.] [6]

(vii) Explain how many principal components are likely to be used. [2]

SARS has a small subsidiary writing similar business in neighbouring Insolvania. Insolvania uses its own currency. The government of Insolvania is widely believed to be on the brink of default on its sovereign debt and consequently its stock market and currency have been under pressure in recent months.

In order to manage its currency risk, SARS uses currency hedges to maintain a stable solvency ratio, which is targeted as 200% of the required economic capital.

(viii) Explain how currency movements could affect the solvency ratio and therefore how currency hedging could be used to maintain a stable solvency ratio. [4]

(ix) Describe the main potential disadvantage of the approach. [2]

SARS believes that it may be transferring more currency risk than it should and that its current objective of maintaining the solvency ratio may be over-restrictive.

(x) Propose two alternative objectives for the currency risk hedging. [2]

The CRO has suggested that, since it is hedged, no capital needs to be held in respect of currency risk.

(xi) Comment on whether capital should be held in respect of currency risk. [2]

SARS is confident that its ERM framework will help it to withstand any Insolvania sovereign debt default crisis.

(xii) Explain the importance of ERM in such an event, including how a strong ERM framework will help SARS before, during and after the crisis. [9]

SARS's reinsurance manager has suggested that SARS should buy contingent business interruption insurance to protect itself from some of the financial impact of the crisis. Contingent business interruption insurance indemnifies the insured against lost profit and extra expenses resulting from events which impact the insured's customers and/or suppliers but which are outside the insured's control.

(xiii) Analyse the risks that could arise from customers and/or suppliers in the event of a sovereign debt default crisis, and so would be covered by the suggested insurance. Your answer should include the difficulties of quantifying these risks. [7]

[Total 59]

2 The Chairman of the trustees of a large defined benefit pension scheme is very much in control of the trustee group. He listens to the viewpoints of others but it is normally the case that decisions are made by him based on his own views, even when these views are not shared by the majority of other trustees. Disagreements amongst the group are resolved by taking the Chairman's preferred solution.

He has stated strongly that he is not interested in analysing emerging risks as they are by definition difficult to understand and assess, and they are unlikely to have a significant impact on the pension scheme compared to other known and existing risks.

(i) Evaluate the risk management culture of the trustee group, based on this information. [8]

The Chairman has now left and a new one has been appointed. The trustees have subsequently decided that it is appropriate to identify and analyse emerging risks.

(ii) Describe how this could be done. [7]

Some of the trustees have read a recent press article on the impact of Earth's diminishing natural resources, and this has been added to the list of emerging risks to consider.

The trustees are concerned that there could be far-reaching implications of diminishing natural resources for the economy, the value of investments and for society in general.

(iii) Describe the potential implications for the pension scheme. [8]

(iv) Suggest actions that the trustees could take to mitigate the risks identified in part (iii). [2]

[Total 25]

3 Easy Retirement is a life insurance company specialising in selling immediate annuities and equity release mortgage products in a large western economy.

The proceeds from the sale of the immediate annuities are invested in corporate bonds and equity release mortgages.

Equity release mortgages allow homeowners in retirement to take out a loan secured against their property. The money raised, up to 30% of the value of the property, could be used by the homeowners for a variety of purposes including redecorating their home, buying a new car or travel.

The interest on the loan is fixed at 6% per annum, and this is added to the balance owed each year. The loan balance is repaid on the sale of the property following the death(s) of the homeowner(s).

Easy Retirement offers a guarantee on its equity release products. If the value achieved on the sale of the property is lower than the loan balance at that time, then Easy Retirement writes off the value of the loan balance in excess of the property value. This crystallises a loss for Easy Retirement on its equity release mortgage portfolio.

A large investment bank has approached Easy Retirement to offer a possible hedge for this guarantee. The bank has suggested that the guarantee could be effectively hedged by purchasing floors on the country's House Price Index ("HPI").

(i) Describe how such a hedge could be constructed. [5]

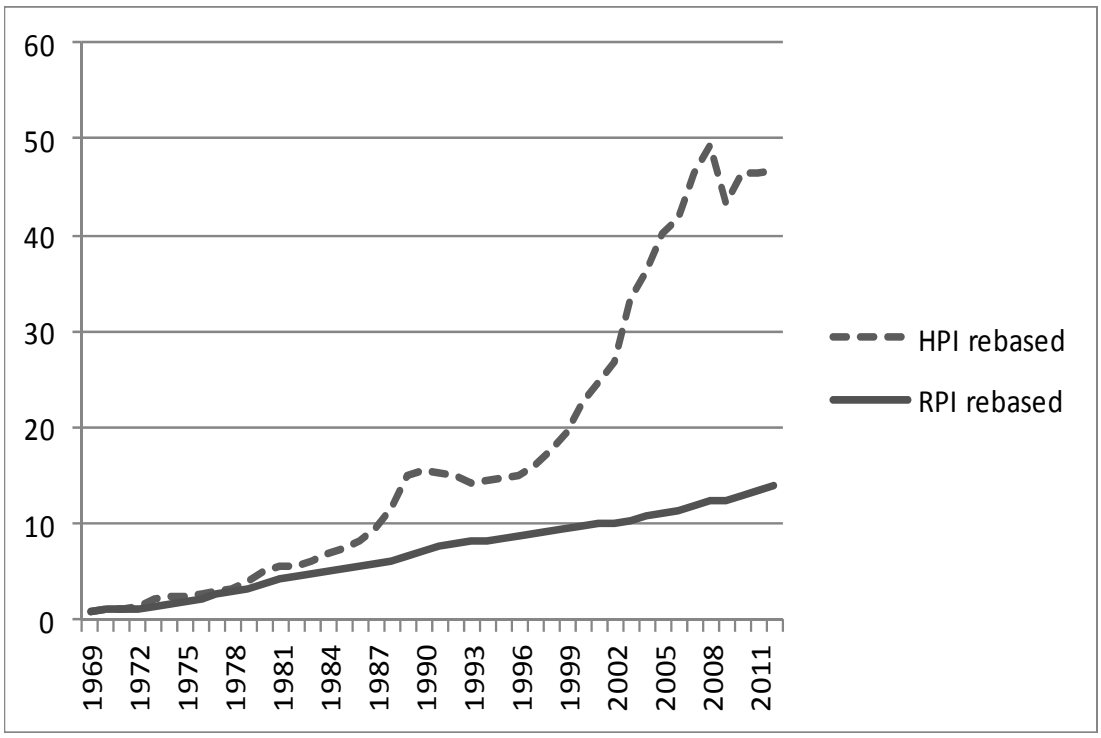
(ii) Describe the weaknesses of hedging the guarantee in this way. [4]

Following market testing, the bank has concluded that there is insufficient liquidity to trade floors on the country's HPI.

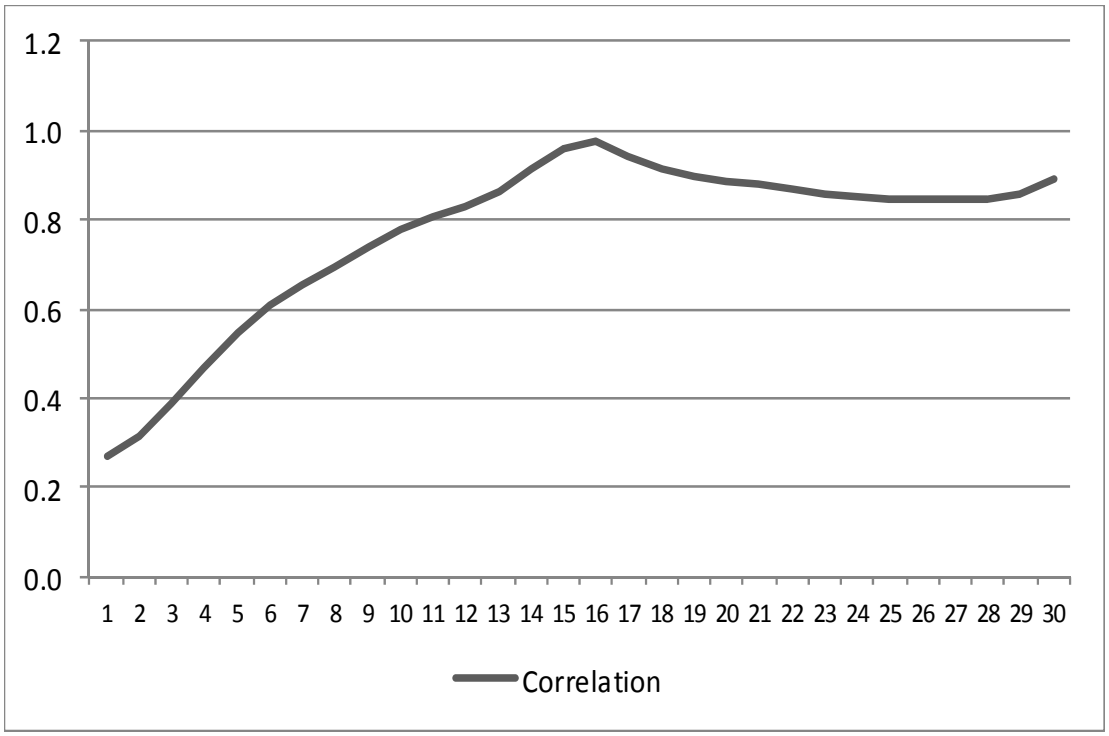
However, the bank has also analysed the country's Retail Price Index ("RPI") and HPI and found the two indices to be highly correlated with over 95% correlation over 15 year periods.

The bank has provided the following supporting analysis and has suggested instead hedging the guarantee using floors on the RPI.

HPI and RPI, rebased to 1 in 1969



Correlation by measurement period in years



(iii) Recommend with reasons whether the guarantee should be hedged using floors on the RPI, based on the information provided. [5]

(iv) Suggest further investigations that could be undertaken in order to improve Easy Retirement's understanding before it makes the final decision. [2]

[Total 16]

END OF PAPER